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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 : F23J 3/02

A1

(11) International Publication Number: WO 85/ 03339

(43) International Publication Date: 1 August 1985 (01.08.85)

(21) International Application Number: PCT/SE85/00008

(22) International Filing Date: 11 January 1985 (11.01.85)

(31) Priority Application Number: 8400275-7

(32) Priority Date: 20 January 1984 (20.01.84)

(33) Priority Country: SE

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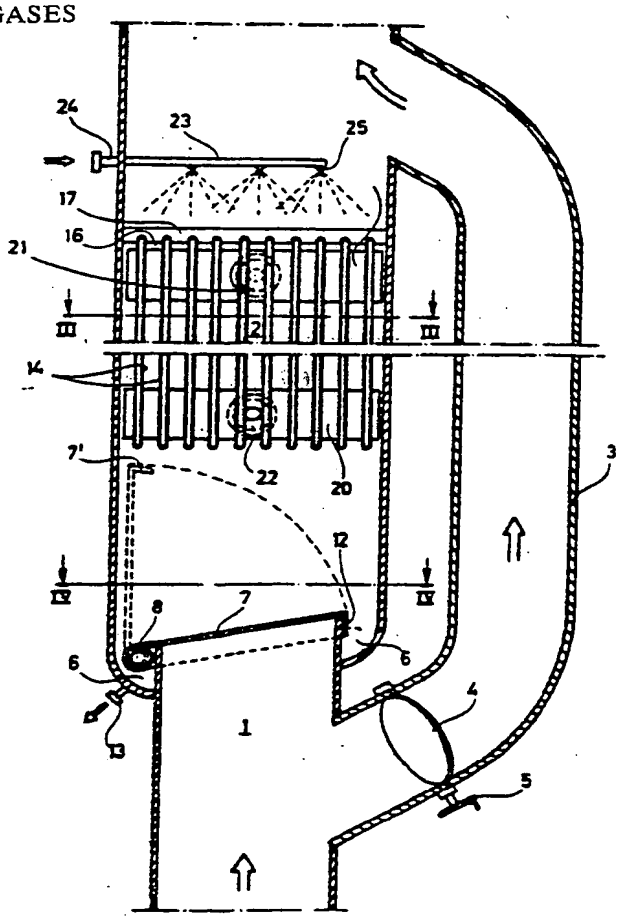
(81) Designated States: AT (European patent), CH (European patent), DE (European patent), DK, FI, FR (European patent), GB (European patent), NO.

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: A DEVICE FOR HEAT RECOVERING FROM FLUE GASES

(57) Abstract

In a device for heat recovering flue gases flowing through an essentially vertical flue, a number of heat exchanger elements (14) are vertically suspended in the flue, in which also liquid rinsing means (23, 25) are provided above the heat exchanger elements (14) for intermittent rinsing of the same. For the collection of intermittently falling washing liquid a collecting device is provided below the heat exchanger elements (14), comprising a collecting groove extending along the inside periphery of the flue, and a flap element (7), which is turnable around a pivot (8) situated peripherally in the flue in order to be turned into essentially a vertical position (7') after a period of cleaning, so that substantially the entire cross-section of the flue defined by the collecting groove (6) is uncovered, and to be turned into a position before a period of cleaning such that it completely covers said cross-section and conducts the falling washing liquid within said cross-section away to said collecting groove (6).



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A device for heat recovering from flue gases

The present invention relates to a device in combustion plants for heat recovering from flue gases, flowing through an essentially vertical flue, by heat exchange with a heat absorbing fluid, which is brought to flow within heat exchanger elements provided in the flue.

Flue gases from combustion plants generally contains dust particles, which have a tendency to deposit on heat exchanger elements installed for heat recovering from the flue gases, even if special dust separators are installed, such as electric filters. In connection with designing of heat exchanger devices for this purpose the possibility of periodical cleaning of the heat exchanger elements, therefore, must generally be provided to maintain a high efficiency of the heat recovering device. One way of solving the cleaning problem is to design the heat exchanger section such that the heat exchanger elements can be reached easily from outside and be cleaned by means of suitable means. Another common way is to install pressurized air or liquid rinsing means in the heat exchanger device for automatic cleaning after a certain period of operation. In both cases arrangements are required for conducting the flue gases past the heat exchanger device during the periods of cleaning; access to the heat exchanger elements from outside requiring a total conduction of the gas flow away from the heat exchanger section, while in automatic cleaning systems there are not the same requirements as to gas tight closure of the flue section before the heat exchanger elements.

Since cleaning of the heat exchanger elements is accomplished by liquid rinsing, some arrangement has to be provided to collect the washing liquid and to conduct it away from the flue. This can be accomplished by means of a bend of the flue such that a liquid seal with a drain outlet can be formed below the heat exchanger

elements. However, such a solution results in increased pressure drops in the flue so that possibly an unnecessary large fan capacity may be required. Further, in connection with heat exchanger installation in existing chimney plants, such a solution often leads to substantially increased construction costs and often is difficult to realize for space reasons.

Another way of accomplishing the required collection of liquid in a vertical flue is to install below the heat exchanging elements, damper members of some known type, by means of which a liquid tight blocking of the flue can be obtained. These installations are very expensive, however, in connection with the large flue cross sections required in industrial combustion plants.

The object of the present invention is to provide a heat exchanger arrangement in a vertical flue with equipment for intermittent rinsing of heat exchanger elements installed in the flue, and a simple and reliable collecting means for the rinsing liquid.

This object is achieved according to the invention in a device comprising a number of heat exchanger elements and means for external liquid rinsing of the heat exchanger elements provided in a heat exchanging zone of a vertical flue, to which also a by-pass channel is connected with an inlet below the heat exchanging zone and an outlet above the heat exchanging zone, said by-pass channel being connectable via necessary damper members to intermittently conduct the flue gases away from the heat exchanging zone, the device being characterized mainly by a collecting means for said washing liquid comprising a collecting groove arranged below the heat exchanging zone along the inside periphery of the flue, said collecting groove communicating with an outlet for the washing liquid, and by a flap element, which is turnable around a pivot situated

peripherally in the flue in order to be turned after a period of cleaning into substantially a vertical position, so that substantially the entire flue cross-section defined by the collecning groove is uncovered, and to be turned before a period of cleaning into a position such that it entirely covers said cross-section and conducts the washing liquid falling within said cross-section away to said collecting groove.

The combination of a stationary collecting groove around the periphery of the flue, and a turnable flap for conducting away during a period of cleaning the washing liquid falling down within the cross-section inside of the collecting groove, makes it possible to obtain a remarkably simple design without requirements on sealing functions. By providing the flap turnable around a shaft situated peripherally in the flue above the collecting groove, almost the entire flue cross-section can be uncovered by setting the flap in a vertical position during normal operation in order to provide for undisturbed flowing of gas up through the heat exchanging zone. According to a preferred embodiment of the invention simplicity as to design of the collecting means, and a completely undisturbed gas inlet to the heat exchanging zone are achieved by forming the collecting groove on the outside of a lower channel section, which is surrounded by an upper channel section, the walls of which are connected to said lower channel section below the edge of its end portion.

Even if circular as well as rectangular cross-sections of the heat exchanging zone, the flap element and the gas inlet are consistent with the invention, it is realized that a rectangular cross-section offers a maximum utilization of the available cross-section for free gas flowing into the heat exchanging zone, and a minimum need of space for the flap element in a vertical position along a straight wall in the heat exchanging zone. Further, a rectangular cross-section may be advantageously

utilized with respect to the choice of heat exchanger elements suited for the purpose. According to a preferred embodiment of the invention the heat exchanger elements are constituted by a number of similar flat laminas, formed by joined rectangular plate elements, said laminas being arranged in parallel side by side with vertically oriented heat transferring surfaces across a rectangular channel cross-section. Further, since these rectangular laminas are fixed only along their vertical edges to two opposite walls of the channel section, straight and open gas flow channels may be obtained between the laminas along relatively even and smooth heat transferring surfaces over almost the entire channel cross-section.

As mentioned above, no sealing function between the flap element and the inlet of the heat exchanging zone is required according to the invention; only that the flap element when it is turned in its lower position covers the gas inlet and conducts falling liquid away to the collecting groove surrounding the gas inlet. In order to make it impossible for even small amounts of washing liquid to splash into the gas inlet from beneath, the flap element according to a preferred embodiment of the invention is arranged to abut against the edge of the gas inlet section, when it is turned in its lower position, the flap element furter being fitted with edge elements, which in said position extends below and surrounds the upwardly projecting edge of the gas inlet.

The invention will now be described in a preferred embodiment thereof with reference to the accompanying drawing, in which:

Fig. 1 shows a vertical section through a flue with a heat recovering device according to the invention,
Fig. 2 shows a sectional, partial view of the liquid collecting device shown in Fig. 1,

Fig. 3 shows a horizontal section through the heat exchanging zone of the flue, and
Fig. 4 shows a horizontal section of the flue between the heat exchanging zone and the liquid collecting groove.

Fig. 1 shows a portion of a vertical flue provided with a heat recovering device according to the invention. A lower flue section of rectangular cross-section forms a gas inlet to a heat exchanging zone 2 also of rectangular cross-section, which is larger than the cross-section of the inlet section 1. A by-pass channel 3 is provided with an inlet below the heat exchanging zone 2 and an outlet above the same and is equipped with a damper member 4 having a control means 5 for opening and closing of the channel.

The walls of the heat exchanging zone 2 are attached to the walls of the inlet section 1 below the end edge of the inlet section such that a liquid collecting groove 6 is formed on the outside of the inlet section 1 and around the same. A rectangular flap 7 is fixed to a shaft 8 journalled in bearing members 9, 10, which are fixed to two opposite walls of the heat exchanging zone 2, so that it extends through the groove 6 outside the inlet section 1. By means of a control means 11 coupled to the shaft 8 outside the flue, the flap 7 is turnable from the shown position, in which it abuts the end edge of the inlet section 1, into substantially a vertical position 7', in which the inlet section is completely uncovered for gas flow into the heat exchanging zone 2. The flap further is provided with edge elements 12, which surround the inlet section 1 when the flap is turned down to its closing position. Since two opposite edges of the inlet section 1, as well as two corresponding wall connections between the heat exchanging zone 2 and the inlet section 1, are somewhat inclined with respect to a horizontal plane, the groove 6 surrounding the inlet section 1 is correspondingly inclined and has a lowest portion along

one side wall of the heat exchanging zone, through which sidewall there is provided an outlet 13 for washing liquid.

In the heat exchanging zone 2 there is a number of similar flat laminas 14, formed by joined rectangular plate elements, said laminas 14 being arranged in parallel side by side, with vertically oriented heat transferring surfaces, across the rectangular cross-section of the heat exchanging zone, such that open vertical gas flow channels 15 are formed between two successive laminas 14. Since spacing members 16 are provided only along two opposite walls of the heat exchanging zone 2 to fix the laminas 14 along their two vertical side edges, almost the entire wall surface defining each gas flow channel 15 will be formed by two relatively smooth rectangular heat transferring surfaces of two successive laminas. This means that the rectangular cross-section of the heat exchanging zone, which is advantageous with respect to the liquid collecting device, can be advantageously utilized also with respect to the heat exchanger unit itself, which unit may be made compact with the described rectangular laminas, and yet offer gas flow channels with a minimum tendency of dust deposition, said gas flow channels also being easily accessible for rinsing by means of washing liquid from liquid distributors provided above the laminas.

The heat exchanger elements or the laminas 14 at the upper end of their two vertical side edges are fixed to a carrying beam member 17 extending along two opposite sides of the rectangular heat exchanging zone 2. The other spacing members 16 provided further down along the end edges of the laminas are preferably not firmly connected to the laminas but are provided with recesses 18 in which the ends of the laminas are movably fixed. For the supply and discharge of heat absorbing medium flowing within the laminas 14, inlet and outlet boxes 19 and 20 with inlet and outlet ports 21 and 22 are provided at the respective upper and lower ends of

the laminas 14, the boxes preferably being connected with the laminas such that the upper and lower portions of the side edges of the laminas open into the inlet box 19 and the outlet box 20, respectively.

Above the laminas 14 there is provided a distribution member 23 for the distribution of washing liquid from an inlet 24 to spray nozzles 25 distributed over the cross-section of the heat exchanging zone 2. As a supplementary means for cleaning of the laminas 14 also pressurized air nozzles (not shown) may be installed above, between or below the laminas 14. In many cases an initial air blowing of the heat exchanger elements may facilitate or improve a subsequent cleaning by liquid rinsing. In some cases the cleaning of the laminas can be completely performed by means of compressed air. Then the collecting device according to the invention is well adapted for liquid rinsing, subsequent to the compressed air treatment, to flush away dust having already been removed from the heat exchanger surfaces.

As mentioned above, for the function of the device according to the invention, there is required no real sealing between the flap 7 and the inlet section 1. Considering a situation when the main flue is blocked before a period of cleaning, for example by means of a butterfly valve between the inlet of the by-pass flow channel 13 and the flap element 7, it is nevertheless realized that the flap element 7 must be arranged such that a gas pressure possibly remaining below the flap can not lift the flap. Therefore, during the period of cleaning there should be applied a moment in the closing direction on the flap 7 through the shaft 8 and the control device 11. If a sufficient moment in the closing direction is applied on the flap 7, the latter may possibly also serve as a closing member for the gas flow in the main flue, so that the need of further damper members therein is eliminated. The flap 7 or the end edge of the inlet section 1 may also be provided with sealing elements of a material resistant to the temperature of the flue gas, as for example Teflon.

Claims

1. A device in combustion plants for heat recovering from flue gases, flowing through an essentially vertical flue, by heat exchange with a heat absorbing fluid which is brought to flow within heat exchanger elemets (14) provided in a heat exchanging zone (2) of said flue, which device comprises a by-pass flow channel (3) for the flue gases with an inlet below the heat exchanging zone and an outlet above the heat exchanging zone, damper members (4, 7) for intermittently conducting the flue gases away from said heat exchanging zone (2) via said by-pass flow channel, and means (23, 25) for external rinsing of said heat exchanger elements (14) by a washing liquid, c h a r a c t e r i z e d b y a collecting device for said washing liquid comprising a collecting groove (6) provided below the heat exchanger elements (14) along the inside periphery of the flue, which collecting groove communicates with an outlet (13) for the washing liquid, and a flap element (7), which is turnable around a pivot (8) peripherally situated in the flue in order to be turned after a period of cleaning into essentially a vertical position (7') so that substantially the entire cross-section of the flue, defined by the collecting groove, is uncovered, and to be turned before a cleaning period into a position such that it entirely covers said cross-section and conducts the falling washing liquid within said cross-section away to said collecting groove (6).

2. A device according to claim 1, c h a r a c t e r i z e d i n that said collecting groove (6) is formed on the outside of a lower channel section (1), the upper end edge of which forms an inlet opening for the flue gas in a subsequent upper channel section (2), the cross-section of which is larger than that of the said lower channel section and the walls of which are connected to the walls of said lower channel section below said end edge.

3. A device according to claim 2, c h a r a c t e r i z e d i n that said flap element (7) in a closing position is arranged to abut the end edge of said lower channel section (1), and that the flap member is provided with edge elements (12) extending below and surrounding said end edge in said closing position of the flap element.

4. A device according to any of the preceding claims, c h a r a c t e r i z e d i n that said heat exchanging zone (2) and said flap element (7) have substantially rectangular cross-section.

Fig.1

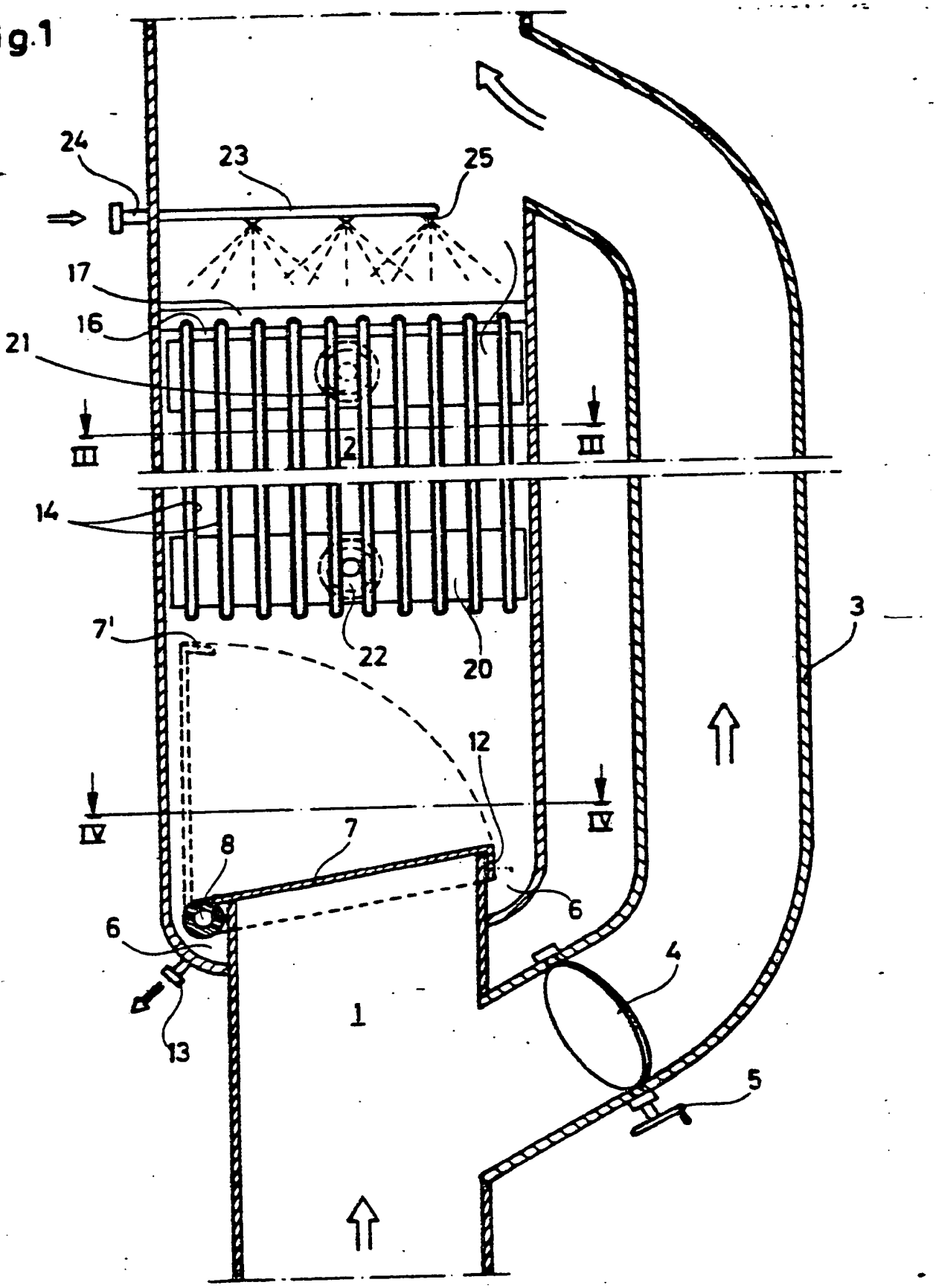


Fig. 2

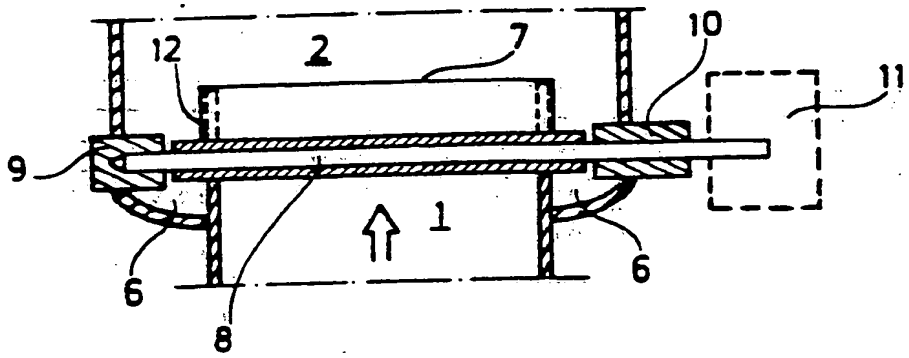


Fig. 3

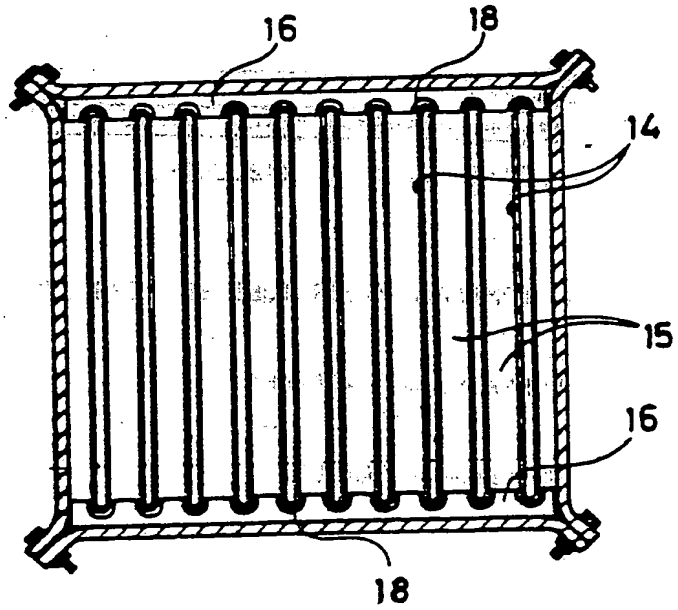
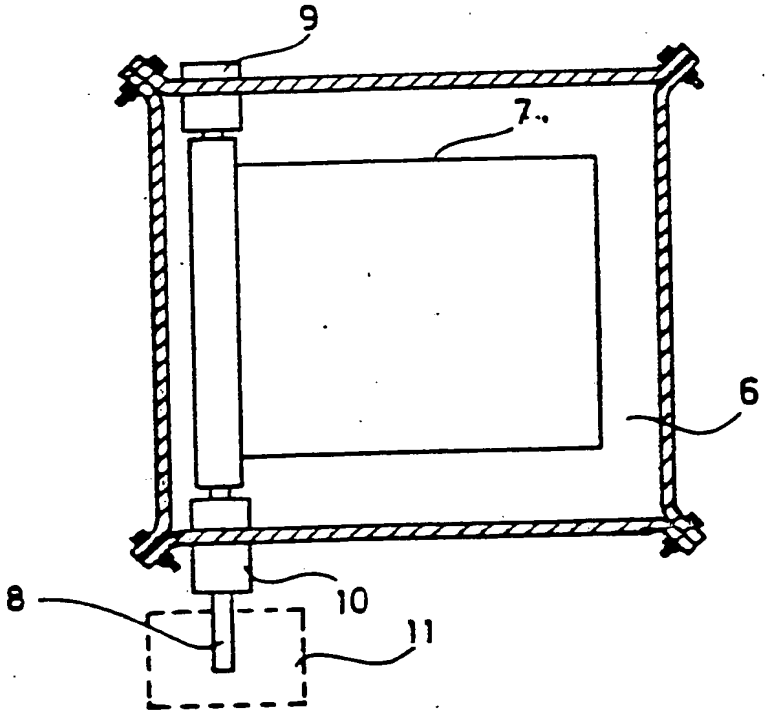


Fig. 4



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE85/00008

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

F 23 J 3/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	F 23 J 3/00,02, 15/00; F 28 D 21/00; F 28 G 1/00,16, 3/00,16, 9/00; F 22 B 37/48, 37/52
Nat Cl	13e:5/02; 17f:5/11; 24d:7; 24g:4/01, 6/50 .../...

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	GB, A, 1 068 193 (KAWASAKI JUKOGYO, KABUSHIKI KAISHA) 10 May 1967	1-4
Y	GB, A, 664 927 (JOHN THOMPSON WATER TUBE BOILERS LTD) 16 January 1952	1
A	NO, C, 60 972 (AB SVENSKA FLÄKTFABRIKEN) 12 June 1939	
A	GB, A, 430 050 (GEORGE EDWARD TANSLEY) 12 June 1935	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1985-02-21	1985 -03- 08
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Jan Carlerud

VH

Form PCT/ISA/210 (second sheet) (January 1985)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields searched (cont)

US Cl 15:316-318;
122:379-405;
165:95

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ....., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers ....., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers ....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.